

Mini Total Organic Carbon Analyzer (miniTOCA)

Completed Technology Project (2011 - 2013)



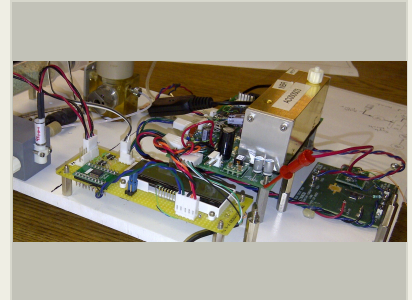
Project Introduction

The objective of this development is to create a prototype hand-held, 1 to 2 liter size battery-powered Total Organic Carbon Analyzer (TOCA). The majority of missions beyond LEO require that all waste water sources on spacecraft be recycled into drinking water and verified clean to protect crew health. Total Organic Carbon (TOC) is the sum of the carbon content of all organic contaminants in the water, and measuring TOC is a key method to monitor over all water quality, and is useful for tracking water processor system performance. If the TOC in the recycled water is kept low (< 1 part per million-ppm), the need to measure specific organic compounds is diminished if not eliminated entirely. This project will develop a greatly simplified and miniaturized TOCA vs. the current state of the art (locker sized, 40 kg). The current state of the art TOCA is fine for International Space Station, but Exploration missions cannot accommodate the mass, volume and power required. The goal of the project therefore is to reduce the mass, volume and power by more than 90%. By miniaturizing the system, the required volume of water for analysis also diminishes. The MiniTOCA is a vital tool that will help enable exploration of space.

Total Organic Carbon (TOC) analyzers function by converting (oxidizing) all organic compounds (contaminants) in the water sample to carbon dioxide gas (CO_2), then separating and measuring the CO_2 produced. The data output is TOC concentration in ppm. Total Inorganic Carbon (TIC) can also be measured in the same analysis. Conventional TOC analyzers use at least 2 externally supplied "reagents," a liquid buffer/oxidizer and a sweep gas to move the product CO_2 to the detector. We intend to eliminate all externally supplied consumables in this project. The MiniTOCA will use a preloaded long-life buffer, extremely small sample volumes (minimizes waste stored internally), and either purified ambient air as sweep gas or generate gas internally by electrolysis. The MiniTOCA subsystems are developed and tested separately, then integrated. Conventional plumbing and complex connections diminish in number dramatically by integrating the subsystems in creative ways. This 2nd year effort focuses on the reactor and quantitative water sample injector plus integration, software and preliminary packaging. Breadboarding to date indicates all the components will fit into a 1liter cube, excluding batteries. The prototype system will be tested and debugged in the JSC Water & Food Lab using challenge solutions prepared in the Lab. The 3rd year of funding will focus on eliminating any gravity dependencies, refining operational aspects, packaging and designs for a flight technology demonstration.

Anticipated Benefits

TOCA is the primary water quality monitor on ISS and could be one of 2 or 3 required for Exploration missions that recycle water. It is therefore critical that TOCA technology be miniaturized, hardened, and flight-tested in preparation



Project Image Mini Total Organic Carbon Analyzer (miniTOCA)

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Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Independent Research & Development: JSC IRAD

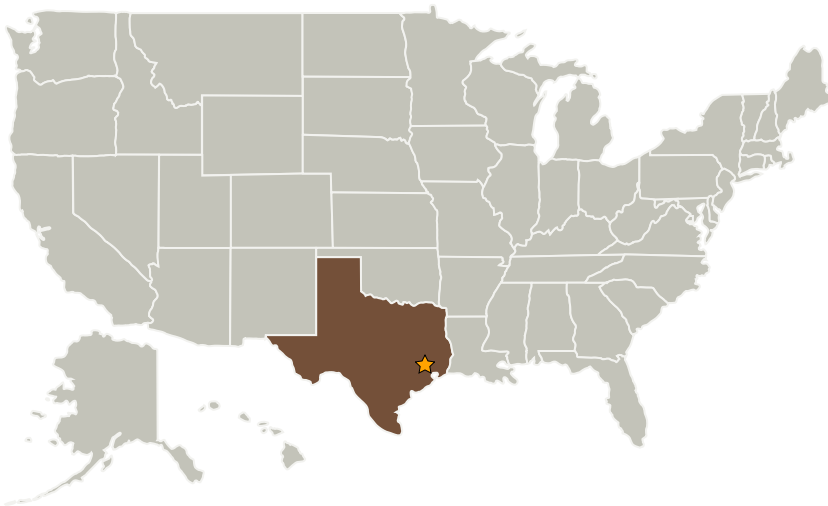
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for Exploration. This project is the first step in that sequence. Utilizing a subsystems approach, this project builds on both ISS TOCA development experience and the results from the first year of funding under the Center Independent Research and Development Program. MiniTOCA subsystems are physically stacked and combined to minimize or eliminate plumbing. Breadboarding is accomplished iteratively, with software (state machine) being written and refined in parallel with subsystem hardware changes. The power draw of the MiniTOCA will be within reach of either laptop USB port or rechargeable batteries. The MiniTOCA will be self-contained and hand-held. Eventually, a MiniTOCA flight system could serve as a back-up to the current TOCA units on ISS.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
KBRwyle, Inc.	Supporting Organization	Industry	Houston, Texas
OI Analytical	Supporting Organization	Industry	

Project Management

Program Manager:

Carlos H Westhelle

Project Manager:

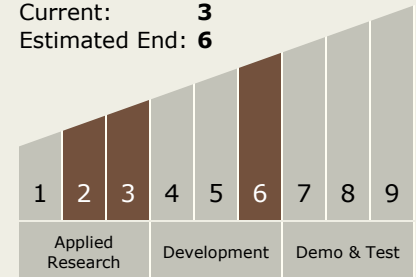
Paul D Mudgett

Principal Investigator:

Paul D Mudgett

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 6



Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - TX07.2 Mission Infrastructure, Sustainability, and Supportability
 - TX07.2.1 Logistics Management

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Primary U.S. Work Locations

Texas

Images



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Project Image Mini Total Organic
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(<https://techport.nasa.gov/image/2016>)